

Sorghum leaf silicification: Spontaneous or induced by the tissue?

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Leaves of grasses accumulate silica up to 10 % of their dry weight, but the mechanism of biosilicification is not known. We recently reported a sorghum mutant, which is defective in absorbing silicic acid from soil and hence accumulates very little silica in its leaves. Our hypothesis is that the mutation is expressed only in the roots, and the leaf silicification mechanism is intact. Induction of silicification in the mutant leaves allowed us to reveal leaf bio-silicification dynamics. We induced silicification in the mutant leaves by bypassing root and supplying Si to the mutant shoot. We then followed the accumulation of silica in specialized epidermal dumbbell shaped cells in elongating leaves. Surprisingly, the older leaves did not accumulate silica at all. This result is in contrast to the tight correlation between silicification and transpiration. Supply of apoplastic Si to cut leaf pieces from elongating leaves also induced dumbbells silicification, even though the leaves did not transpire. Pieces from older leaves did not deposit silica. Viability assay showed that the dumbbells are non-viable before silicification. Collectively these results suggest that silicification starts only in fully mature cells, probably after programmed death. The cells are receptive to silica only for a short period of time, after which they do not silicify. Contrary to the common assumption that silica forms from Si as a result of water loss, our results suggest that the dumbbell silica cells accumulate a biochemical that actively polymerize silica.